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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/608,567	06/30/2000	Douglas M Carmean	042390.P8007	1457

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Jeffrey S Draeger
Blakely Sokoloff Taylor & Zafman LLP
12400 Wilshire Boulevard
7th Floor
Los Angeles, CA 90025

EXAMINER

TSAI, HENRY

ART UNIT	PAPER NUMBER
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2183

DATE MAILED: 08/13/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/608,567

Applicant(s)

CARMEAN ET AL.

Examiner

Henry W.H. Tsai

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 5/26/04.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-38 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-18 and 20-38 is/are rejected.
- 7) ☒ Claim(s) 19 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

2. Claims 1-17, 20-32, and 34-38 are rejected under 35 U.S.C. 102(a) as being anticipated by Grochowski (US Patent No. 6,047,370), hereafter referred to as Grochowski.

Referring to claim 1, Grochowski disclosed, as claimed, an apparatus comprising: an execution unit (processor pipeline 10, see Fig. 2) to execute an instruction; a replay system (comprising queue 15 and channel 17, see Fig. 2) to replay an altered instruction (see col. 7, lines 25-26, such as when a predicate misprediction causes an error in the execution, the original instruction will be altered by inserting the correct predicate therein) formed from changing said original instruction (see Col. 7, lines 30-34, regarding "the problem can

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be identified and corrected in the queue 15 and the execution stream replayed) if the execution unit executes the instruction erroneously (see Col. 7, lines 9-13, for the exemplary problems, and Col. 7, lines 25-29, for how the altered instruction to be formed from changing said original instruction).

Referring to claim 20, Grochowski disclosed, as claimed, a processor (comprising processor pipeline 10, see Fig. 2) comprising: a scheduler (certainly existing in the processor comprising processor pipeline 10, see Fig. 2) to dispatch an original instruction (through the processor pipeline 10, see Fig. 2); an execution unit (certainly existing in the processor comprising processor pipeline 10, see Fig. 2) to attempt execution of the original instruction; a checker (certainly existing, see Col. 7, lines 45-46, regarding instructions being checked contain a problem and needed to be replayed) to determine whether the original instruction executed properly; a replay system (comprising queue 15 and channel 17, see Fig. 2) comprising: a replay loop to replay the original instruction (see Col. 7, lines 30-34, regarding "the problem can be identified and corrected in the queue 15 and the execution stream replayed); a morphing circuit (certainly existing since the instruction will be changed) to change the original instruction into an altered instruction (see col. 7, lines 25-

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26, such as when a predicate misprediction causes an error in the execution, the original instruction will be altered by inserting the correct predicate therein) and to replay the altered instruction (see Col. 7, lines 9-13, for the exemplary problems, and Col. 7, lines 25-29, for how the altered instruction to be formed from changing said original instruction).

Referring to claim 24, Grochowski disclosed, as claimed, a method comprising: executing an original instruction (the instructions entering the Grochowski's system from front end 12, see Fig. 2); determining if a first (in the Grochowski's system when the instruction has new problem, see Col. 7, lines 55-64) occurs; if said first condition occurs, then morphing said original instruction to form a morphed instruction (see col. 7, lines 25-26, such as when a predicate misprediction causes an error in the execution, the original instruction will be altered by inserting the correct predicate therein); and executing said morphed instruction (see Col. 7, lines 9-13, for the exemplary problems, and Col. 7, lines 25-29, for how the morphed instruction to be formed from said original instruction).

Referring to claim 29, Grochowski disclosed, as claimed, an article comprising a machine readable medium that stores data

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(certainly the data stored in the main memory of the processor comprising processor pipeline 10, see Fig. 2) representing an integrated circuit comprising: an execution unit (certainly existing in the processor comprising processor pipeline 10, see Fig. 2) to execute an instruction; a replay system (comprising queue 15 and channel 17, see Fig. 2) to replay an altered instruction (see col. 7, lines 25-26, such as when a predicate misprediction causes an error in the execution, the original instruction will be altered by inserting the correct predicate therein) if the execution unit executes the instruction erroneously (see Col. 7, lines 9-13, for the exemplary problems, and Col. 7, lines 25-29, for how the altered instruction to be formed from changing said original instruction).

Referring to claim 34, Grochowski disclosed, as claimed, an article comprising a machine readable carrier medium having stored thereon data (certainly the data stored in the main memory of the processor comprising processor pipeline 10, see Fig. 2) which, when loaded into a computer system memory in conjunction with simulation routines, provides functionality of a model comprising: an execution unit (certainly existing in the processor comprising processor pipeline 10, see Fig. 2) to execute an instruction; a replay system (comprising queue 15 and channel 17, see Fig. 2) to replay an altered instruction if the

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execution unit executes the instruction erroneously (see Col. 7, lines 9-13, for the exemplary problems, and Col. 7, lines 25-29, for how the altered instruction to be formed from changing said original instruction).

As to claims 2, 21, 30, and 35, Grochowski also discloses the replay system comprises: a replay loop (through channel 17, see Fig. 2) to replay the instruction under a first condition (in the Grochowski's system when the instruction has an initial problem, see Col. 7, lines 55-64); and an instruction morphing circuit to replay the altered instruction under a second condition (in the Grochowski's system when the instruction has new problem, see Col. 7, lines 55-64).

As to claims 3 and 22, Grochowski also discloses: the replay system comprises: a replay loop (through channel 17, see Fig. 2) to replay the instruction if the instruction is a first instruction condition (in the Grochowski's system when the instruction has an initial problem, see Col. 7, lines 55-64); and an instruction morphing circuit to replay the altered instruction if the instruction is a second instruction condition (in the Grochowski's system when the instruction has an initial problem, see Col. 7, lines 55-64; see also Col. 7, lines 30-34, regarding "the problem can be identified and corrected in the queue 15 and the execution stream replayed").

As to claims 4 and 23, Grochowski also discloses: the first instruction is one of a plurality of non-modifiable instructions (note certainly, the Grochowski's non-modifiable instructions are different from the modifiable instructions thereof and can be classified as the first and second instruction respectively) and the second instruction is one of a plurality of modifiable instructions.

As to claim 5, Grochowski also discloses: the plurality of modifiable instructions are morphed only if a failure in their initial execution occurs (see Col. 7, lines 30-34, regarding "the problem can be identified and corrected in the queue 15 and the execution stream replayed").

As to claim 6, Grochowski also discloses: replay system tracks at least one extra bit (mask bit indicated within Col. 7, lines 43-46) to allow alterations of instructions.

As to claims 7 and 27, Grochowski also discloses: said apparatus comprises a low level cache and a higher level cache (certainly existing in systems such as Grochowski's system), wherein the replay system is to alter a load instruction that has already missed (see col. 7, line 9 for the cache miss situation and lines 17-18 for the memory access problem) in the higher level cache to thereafter only access the low level cache.

As to claims 8 and 28, Grochowski also discloses: said apparatus comprises a page miss handler (certainly existing) to handle instructions that cause page faults (see Col. 7, lines 11-12, regarding the page fault problem), wherein the instruction is a memory access that causes a page fault, and wherein the replay system is to change the memory access to one or more memory accesses (see col. 7, lines 17-18 regarding the memory access problem) to handle the page fault (note this is certainly existing in the Grochowski's system since the Grochowski's system only replays the back end 14 rather than stalls or replays the entire pipeline 10, see Col. 8, lines 1-3). .

As to claim 9, Grochowski also discloses: the replay system is to replace the memory access with a page descriptor read, then to replace said page descriptor read with a page table entry read, then to reinstate the memory access (note this is certainly existing in the Grochowski's system since the Grochowski's system use the reply system to handle the memory access problems, see col. 7, lines 17-18 regarding the memory access problem). .

As to claim 10, Grochowski also discloses: said instruction is a dependent instruction that is dependent on a result from a previous instruction, and wherein the replay system is to alter

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the dependent instruction to avoid execution in further iterations through the replay system until the previous instruction has successfully executed (see Col. 7, lines 55-67, regarding "the each **iteration** of the back end 14 progresses toward retirement of the instructions from which the micro-ops were generated. Techniques for predicting control and data dependencies are sophisticated and sufficiently accurate that the replay is the exception rather than the rule").

As to claim 11, Grochowski also discloses, as best understood: the replay system is to alter the dependent instruction by setting a valid bit (mask bit indicated within Col. 7, lines 43-46) for the dependent instruction to indicate that the instruction is invalid.

As to claim 12, Grochowski also discloses: the replay system is to alter the dependent instruction back into an executable form when said previous instruction retires (see Col. 7, lines 55-67, regarding "the each **iteration** of the back end 14 progresses toward retirement of the instructions from which the micro-ops were generated. Techniques for predicting control and data dependencies are sophisticated and sufficiently accurate that the replay is the exception rather than the rule").

As to claim 13, Grochowski also discloses, as best understood: the replay system is to reset the valid bit when any

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instruction retires (see Col. 7, lines 55-67, regarding "the each **iteration** of the back end 14 progresses toward retirement of the instructions from which the micro-ops were generated").

As to claim 14, Grochowski also discloses: the replay system is to track a sequence number for the previous instruction and wherein the replay system is to return the dependent instruction to an executable form when said previous instruction completes (see Col. 7, lines 55-67, regarding "the each **iteration** of the back end 14 progresses toward retirement of the instructions from which the micro-ops were generated. Techniques for predicting control **and data dependencies** are sophisticated and sufficiently accurate that the replay is the exception rather than the rule").

As to claim 15, Grochowski also discloses: the apparatus further includes a cache, and wherein the replay system is to return the dependent instruction to an executable form when a write to the cache occurs (certainly existing in systems such as Grochowski's system; see also col. 7, line 9 for the cache miss situation).

As to claim 16, Grochowski also discloses: instruction is a high precision instruction and said replay system is to generate a first result and then the altered instruction is to be executed to generate a final result from the first result (note

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as shown in Col. 7, lines 29-30, the queue 15 has stored the intermediate state of the pipeline 10).

As to claim 17, Grochowski also discloses: said execution unit is a numeric execution unit and wherein said replay system is to a detect data dependent condition for the instruction and to provide the altered instruction to achieve an identical result (see Col. 7, lines 55-67, regarding "the each **iteration** of the back end 14 progresses toward retirement of the instructions from which the micro-ops were generated.

Techniques for predicting control and data dependencies are sophisticated and sufficiently accurate that the replay is the exception rather than the rule").

As to claim 25, Grochowski also discloses: determining if the first condition occurs further comprises: determining whether the original instruction executed improperly (see Col. 7, lines 30-34, regarding "the problem can be identified and corrected in the queue 15 and the execution stream replayed).

As to claim 26, Grochowski also discloses: determining whether a second condition (in the Grochowski's system when the instruction has an initial problem, see Col. 7, lines 55-64)occurs; if said second condition occurs, then replaying said original instruction for execution.

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As to claim 31, Grochowski also discloses: the data representing the integrated circuit comprises a functional description of the integrated circuit (certainly existing in the systems such as Grochowski's system since it comprises functions units.

As to claim 32, Grochowski also discloses: the data representing the integrated circuit comprises a hardware description language code (certainly existing in the systems such as Grochowski's system since it comprises functions units.

As to claims 36-38, Grochowski also discloses: the altered (or morphed) instruction (see col. 7, lines 25-26, such as when a predicate misprediction causes an error in the execution, the original instruction will be altered by inserting the correct predicate therein) to cause the execution unit to perform a different function than the original instruction (since the original instruction has been altered (or morphed), it will cause the execution unit to execute different micro-instructions and therefore, perform different function).

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Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 18 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grochowski.

Grochowski discloses the claimed invention except for: the instruction is a rounding instruction and the altered instruction is an add instruction (claim 18); and the data representing the integrated circuit comprises data representing a plurality of mask layers. (claim 33).

However, Examiner submits as an official notice that "the situation when instruction is a rounding instruction and the altered instruction is an add instruction" is well known in the art in order to effectively use the hardware and software resources.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Grochowski's system to comprise the original instruction being a

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rounding instruction and the altered instruction being an add instruction in order to effectively and flexibly use the hardware and software resources.

Further, Examiner submits as an official notice that using the data representing the integrated circuit comprising data representing a plurality of mask layers is also well known in the art in a data processing.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Grochowski's system to comprise the data representing the integrated circuit comprising data representing a plurality of mask layers in order to facilitate controlling the data processing for the Grochowski's system.

Allowable Subject Matter

5. Claim 19 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

6. The following is a statement of reasons for the indication of allowable subject matter: Grochowski (US Patent No.

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6,047,370), the closest reference, and the other cited prior art do not teach or fairly suggest: the numeric execution unit lacks hardware to compute one or more relatively rare numeric cases and wherein such relatively rare numeric cases are instead implemented by injecting, via the replay system, the altered instruction to achieve an effectively identical result (in claim 19).

Response to Arguments

7. Applicant's arguments filed 5/26/04 have been fully considered but they are not deemed to be persuasive.

Applicant argue that Grochowski does not suggest replaying an altered instruction formed from changing the original instruction if the execution unit executes the instruction erroneously (page 11, lines 20-21). Examiner disagrees with Applicant. As set for in the art rejections above, Grochowski disclosed, as claimed, an apparatus comprising: a replay system (comprising queue 15 and channel 17, see Fig. 2) to replay an altered instruction (see col. 7, lines 25-26, such as when a predicate misprediction causes an error in the execution, the original instruction will be altered by inserting the correct

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predicate therein) formed from changing said original instruction (see Col. 7, lines 30-34, regarding "the problem can be identified and corrected in the queue 15 and the execution stream replayed) if the execution unit executes the instruction erroneously (see Col. 7, lines 9-13, for the exemplary problems, and Col. 7, lines 25-29, for how the altered instruction to be formed from changing said original instruction).

Regarding the first example given by Grochowski, the case of a predicate misprediction, Applicant argues that providing the proper predicate to an instruction does not morph that instruction. Providing the proper predicate is akin to providing the proper branch address or operand. The underlying instruction is not altered (page 11, lines 30-33 and page 12, lines 1-6). Examiner disagrees with Applicant. As set forth above, col. 7, lines 25-26 in Grochowski indicates when a predicate misprediction causes an error in the execution, the original instruction will be altered by inserting the correct predicate therein. Inserting the correct predicate to the original instruction is considered as altering the instruction.

Regarding the second example given by Grochowski, a load/store conflict, Applicant argues that there is no alteration necessary to retry or replay the exact same instruction at a later time (page 12, lines 11-12). Examiner

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realizes the situation. However, this is not the example used to teach the claimed invention.

In summary, as set forth in the art rejections above, by Grochowski (US Patent No. 6,047,370) anticipates the claimed invention.

Conclusion

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Contact Information

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9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Henry Tsai whose telephone number is (703) 308-7600. The examiner can normally be reached on Monday-Thursday from 8:00 AM to 5:00 PM. If attempts to reach the examiner by telephone are unsuccessful, the examiner supervisor, Eddie Chan, can be reached on (703) 305-9712. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the **TC 2100 receptionist whose telephone number is (703) 305-3900.**

10. In order to reduce pendency and avoid potential delays, Group 2100 is encouraging FAXing of responses to Office actions directly into **the Group at fax number: 703-872-9306.**

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HENRY W. H. TSAI
PRIMARY EXAMINER

August 9, 2004